Supplement to The Builder,

JULY 19, 1884.

THE ROYAL INSTITUTE OF BRITISH ARCHITECTS: CONFERENCES AT THE INTERNATIONAL HEALTH EXHIBITION.

THE first of a series of Conferences on the subject of "The Construction of Houses with regard to Sanitary Arrangements," organised by the Royal Institute of British Architects, was held on Thursday, the 10th inst. Mr. Ewan Christian, President of the Institute, was the chairman for the day, Mr. Charles Barry, F.S.A., being vice-chairman. There was a large attendance.

The Chairman, in opening the proceedings, referred to the great importance of the subject before the Conferences, and stated that the Institute did not, of course, hold itself responsible for the opinions of any individual speaker. The general question of house building was one of the most important questions of the day, and people should bear in mind Lord Bacon's wise aphorism,—"He that buildeth a house on an ill site committeth himself to prison." The same might be said of him that buyeth a house on an ill site.

ON THE CONSTRUCTION OF HOUSES WITH REGARD TO SANITARY ARRANGEMENTS.

THE introductory paper was on this subject, and was read by Professor T. Roger Smith, who commenced with a brief historical review of the history of the English habitation. He said:—From the best preserved of the Mediæval castles, such as Conway Castle, we may learn that the elementary principles of sanitation were understood, and pains and care taken to secure comfort and even luxury, so far as they can be enjoyed within the restricted boundaries of a fortified dwelling; while the semi-fortified houses, of which a few remain in tolerable preservation, such as Penshurst, Ightham, Warwick Castle, and Haddon Hall, were many of them so complete that they continue habitable even by this fastidious generation.

Monastic buildings, from a time long before the Conquest down to the Reformation, afforded a series of admirably well-planned and well-built dwellings, for the residence in common of a large number of inmates, the general idea of which survives in the colleges of Oxford and Cambridge. The neighbouring detached but dependent buildings, such as the abbot's house, the mill, and the grange belonging to a monastery, were each and all of them good specimens of small dwelling-houses. They were, however, in all probability, far better than the houses which surrounded them, if we may credit a curious but by no means flattering account of the ordinary English dwelling-house at the close of the Middle Ages which has been lately made public in Brewer's "Henry VIII." It is from the pen of Erasmus, who, writing to Wolsey's physician on the dwelling-houses of England in the early years of the reign of Henry VIII., says:—"First of all, Englishmen never consider the aspect of their doors and windows; next, their chambers are built in such a way as to admit of no ventilation. Then a great part of the walls of the house is occupied with glass casements, which admit light, but exclude the air, and yet they let in the draught through holes and corners. The floors are in general laid with white clay, and are covered with rushes, occasionally removed, but so imperfectly that the bottom layer is left undisturbed sometimes for twenty years, harbouring abominations not to be mentioned. I am confident the island would be much more salubrious if the use of rushes were abandoned, and if the rooms were to be built in such a way as to be exposed to the sky on two or three sides; and all the windows so built as to be opened or closed at once, and so completely closed as not to admit the foul air through chinks, for as it is beneficial to health to admit the air, so is it equally beneficial at times to exclude it."

After the time of the confiscation of church property, under Henry VIII., a large amount of house-building on a great scale occurred. Of the vast Elizabethan and Jacobean mansions we are justly proud; and it is very doubtful whether the influence of Italian and French examples in the seventeenth and eighteenth centuries was not on the whole disadvantageous. Certainly some of the Palladian mansions of about a hundred years ago are less carefully disposed for health, decency, and comfort than the Elizabethan ones which preceded them.

If we try to form an estimate of our actual condition, it will soon become clear that, with our present habits of life, the influence of the dwelling on the health of its inmates is very great. I am inclined to believe that it is much greater than at any previous period. Indoor occupations, for men, are far more common than they used to be, and probably though women have to a large extent lived in the house for several centuries they now do so more than ever.

After enumerating briefly some of the most important points which have to be considered in house sanitation, such as adequate ventilation, sufficient means of warming, ample windows, sound construction, protection from noxious compounds in the paint or paperhangings used for the dwelling, complete systems of drainage and of ventilation for the drains, and an ample supply of pure water, hot and cold, the Professor said he proposed to conclude by a reference to the share which *the architect* may properly claim in the duty and privilege of promoting public health by improving the construction of dwellings:—

In other words, I propose to ask how far all this is an architect's question. It is not sufficiently known to the general public, but well known to ourselves, that the actual direct control possessed by architects over the majority of the dwelling houses built in England is extremely small. In ninety-nine cases out of a hundred the dweller in or near one of our towns, especially this metropolis, never dreams of building his own house, and looks out for one ready built by a speculator, and puts up with untold inconveniences and even dangers from its many defects. But notwithstanding all this, the opportunities which we possess of influencing the buildings of this country are very great; they are such as no other body of men enjoys. We can do a great deal to secure that the homes of England are healthy; and if we fail to do all that we can, we shall be failing in a great public duty.

In the first place, I think it may be safely affirmed that whatever may be the case in towns, the country house of a person of influence and importance is now never built without an architect. From parsonage houses upwards we have the designing and superintendence of all the houses of the clergy in their parishes, and the rich when they are living on the estates. These, then, we can make as fit to promote health and to avert disease as we are able, and they ought to be as healthy as any buildings can be. Collectively they provide for a vast number of residents, including a great proportion of the most important men and women of the country; and, in addition to this, they are conspicuous as models. The dwellings of the highly-placed should be perfect, not only for their own sake, but because such buildings are sure to be imitated, and their owners are most likely to promote sanitation when their own dwellings teach them what it means.

Next perhaps in importance from our present point of view are our countless residential institutions, if that term may be used to denote public buildings where persons live temporarily or otherwise. Every college, school, hospital, workhouse, &c., has its architect, and we have even seen military barracks erected by civil architects. The very purpose of these buildings renders attention to their sanitation one of the most positive duties of the architect.

At the other end of the scale the very numerous model dwellings erected in London and other cities for the urban labouring population, and not a few agricultural labourers' dwellings, are almost always put into the hands of architects, and are buildings in which sanitary excellence is often the only good quality that the architect has an opportunity to impart. Between these two extremes lie the numerous dwellings of the middle class, which, as has been said, are far less under an architect's control than the buildings above or below them; yet it must not be forgotten that from time to time an individual house is commissioned, and ought to become a model. I trust I have shown sufficient reasons for our recognising that this is pre-eminently an architect's question, and, if that be admitted to be the case, it will hardly be necessary for me to bespeak your best attention to those of our professional brethren who are to address us on some of the details of the subject, and ask you to contribute to its elucidation by joining with spirit in the discussions.

THE SANITARY ARRANGEMENT OF HOUSES IN LONDON DURING THE LAST 120 YEARS.

Mr. Frederick W. Hunt read a paper on this subject. He said that in speaking of the sanitary arrangements of houses in London during the past 120 years, the points that present themselves for especial consideration are:—

1. Drainage, and the appliances in connexion with it.
2. Water-service, and its supply and arrangements.

And also the general arrangement of the houses during that period, and the use of the several parts and their ventilation.

Before the commencement of this century there was not any system of public or general drainage existing, the so-called sewers being provided for the purpose of carrying off surface water only, or for conducting fouled streams along their old courses. As new squares and streets were laid out and houses erected, sewers were formed under the new roadways; but these were still only for surface water, and it was illegal to conduct any fœcal matter into them. In the formation of these sewers, therefore, the questions of a proper fall, or construction with a view to proper cleansing, do not seem to have been considered essential by the engineer or builder. When, after 1815, it was allowed to carry the overflows from cesspools and other foul drains of houses into sewers, the existing sewers, constructed for the purposes before mentioned, were used, and some have continued in use until the present time, being sometimes only elongated cesspools with the outfall higher than the upper end.

When there were not any sewers for the reception of house drainage, each householder, large or small, had to provide for the reception and storage of all soil or refuse upon his own premises, until it could be removed with as little annoyance to himself or his neighbour as possible. The arrangements of houses, therefore, in the metropolis differed but little from those in the country, with the exception that those in town had not the space or accommodation the country afforded for the conveniences required.

Cesspools or cesspits were the means provided for the reception of all soil and sewage matter. These were usually constructed in the yards or gardens of the larger houses.

House-drains, similarly to sewers, were originally constructed to take the waste and surface water, and being for this purpose only, they were not very carefully laid, and were generally square in section, and frequently without any

paved bottom. These drains were connected with the sewer if one existed within reach, otherwise they had to go to a cesspool. In houses built after, or only immediately preceding, the commencement of this century, when the introduction of a water-closet into houses was becoming general, the drains were made of brick, circular in form, and such as are now called brick-barrel drains. These drains were constructed with mortar as a rule, though sometimes a portion of the bottom was laid in cement, and they still discharged into cesspools from which overflows were carried away. No doubt the overflow was frequently connected with the public sewer, but it was not until 1815 that the penalty against such connexion was removed. With means of overflow, and drainage allowing as it did of the use of a greater quantity of water, and at the same time obviating the necessity for emptying cesspools so frequently, water-closets, instead of privies, were generally provided for houses built at and after the commencement of this century, not only internally but externally. The difficulty that then presented itself to the builders was the keeping back of foul smells, which was provided against by traps in soil-pipes and dip-traps at the bottom of pipes, frequently so large that they might be called cesspools.

Previous, therefore, to this century, and for the first quarter of this century, we find a gradual suppression of privies, and the introduction into houses of water-closets, using the old flat bottom drains, or such drains as had been originally laid down, and these discharging into cesspools. It appears to have been considered that a drain would do for any purpose the needs of the occupier might require it to serve, and when all fœcal and offensive matter could be washed away out of sight, and traps were supplied to keep back offensive smells, it was sufficient to allow this refuse to find a lodgment in cesspools under the floors of the house, or for that matter on the surface of the ground under the floors. When one cesspool became no longer serviceable, rather than cleanse it a new one was made, and the drain directed to it. The site selected for the new cesspool was one that was convenient for the drain rather than for the health of the house.

Much has been done during the last few years in advancing sanitary knowledge, and I think I may summarise the principles gradually accepted, and now more generally acted upon as being,—increased fall to drains,—perfect water-tight joints,—the abolition of dip-traps,—keeping all drains outside the house,—disconnecting them from the main sewers,—the efficient cleansing of drains and the quick removal from them of all obnoxious matter,—the separation of surface water and sink and other wastes from soil drains,—and a continual free current of air through the drains from near their entrance to the sewers along them and up the soil-pipes.

One hundred and twenty years since, water-closets, as such, had scarcely been introduced. The form of such closet at first in use was no more than a receptacle capable of being washed out, from which a pipe was carried to the drain, having a plug to close the upper end, somewhat like a hopper-pan without a trap. This was fitted up in a cupboard or in a room, where convenient to the occupier, and provided with a seat.

Between 1770 and 1780 the first on record of several patents were taken out for an improved apparatus. The earliest were on the principle of a valve-closet, but the kind of apparatus known as the pan-closet, with a large container, came into use very generally at the commencement of this century.

The pipes from the apparatus to the drains have usually been made of lead. Other materials, such as earthenware pipes and iron pipes, have been used, but each of these were found to have faults greater than lead pipes. When it was found necessary to keep back foul smells, D-traps, and traps of various kinds, were introduced. These were formed in connexion with the pipes, and a dip-trap was built at the bottom of the descending pipe. As offensive smells were more and more objected to, the traps were increased in number and size, but the acceptance of the principles now acted upon, and referred to above, has gradually led to the abandonment of the dip-traps at the bottom of the pipe altogether, and to constructing one trap in connexion with the apparatus as small as possible.

After some remarks on wastes, sinks, and baths, Mr. Hunt proceeded to the subject of water-supply, mentioning the dates of the formation of some of the leading water companies:—The Lambeth in 1785; the Vauxhall in 1805; the West Middlesex in 1806; the Kent in 1809; the Grand Junction in 1811.

The water-supply to houses was generally to one or more cisterns in the basement, according to the size of the house, one being placed in the front area; and when there was a second, it was placed at the back part of the house. At first, as the facility for a high service was very restricted, and the cost great, it was seldom used. A small cistern was afterwards placed over the water-closet, as such an addition was made to the house, and the water companies were able to give a higher service.

The service in the house was at first by a tap in the side of the cistern, but it was soon extended to the sinks for convenience. The waste from the cistern was generally by a trumpet-mouthed waste led direct to the drain, or to the trap under the water-closet apparatus, as the case might be, without any further trap or disconnexion, and the supply was taken from the same cistern for all purposes.

The general position for the water-closet in the earliest days of its introduction was designedly in the centre of the house, near the best bedrooms, and where the descending pipes conveying the rain-water from the roof was available for use as a soil-pipe. Light and ventilation there was none, except by a fanlight or small window on to the staircase. Water-closets continued to be placed in this position until near 1850, and in large houses there were two or more so placed on the different floors of the house, and some that could have been as readily lighted and ventilated from the outside were not. The position of the water-closet for the use of the servants, and those in houses of the middle and lower classes, was frequently in the front vault, equally without light.

Houses formerly occupied by single families of the middle classes, but since becoming occupied by a family in each room, have remained without any improvement in this respect. They are still only provided with one water-closet, with a hopper basin and a defective supply of water, placed in a vault in perfect darkness, and where cleanliness is really a difficulty to attain.

Ventilation.—In houses built about 120 years since and later, the reception-rooms in large houses, and even generally, do not call for any special remark in this respect, but the offices and bedrooms were arranged rather to give the greatest accommodation than the best.

Borrowed light and borrowed ventilation was not considered to be undesirable, and the height and dimensions of the sleeping-rooms generally were of the smallest. The changes gradually adopted have been to make all sleeping-rooms higher, and give them all direct external light and ventilation, and to add other means of ventilation besides open windows.

As a concluding remark, I would say that the alterations in the sanitary arrangements of houses, during the period I have referred to, have been gradual, and until recently very reluctantly adopted. It has been, and still is, a difficult matter to persuade people of the necessity of making such alterations to their houses; and some prefer to ignore the fact that their houses are in an unsatisfactory state. There is a very prevalent idea that officers of health and inspectors of nuisances have had all objectionable arrangements done away with, and that no one would think of allowing any such to exist; whereas, I think it is rather a fact that those officers never interfere until the arrangements have become most defective, and are a serious nuisance felt by all in the neighbourhood, and that they seldom think of inspecting or interfering with the arrangement of houses of the middle and upper classes.

In the discussion which followed,

Professor Kerr remarked that it was not so very long since there were none of the appliances which had been referred to to be found inside our houses. The upshot was that there had been created underground an immense ramified world of filthy canals most favourable for the generation of poison. With this abominable underground world they had connected almost every room in their houses, admitting the poison which was generated there. As his contribution towards a solution in part of the great difficulties with which they had to deal, he would state a few propositions which had been in his mind for many years. He would first lay down the following preliminary observations:—(1.) The atmospheric air has for perhaps its principal function, the universal work of cleansing. It performs this work automatically and indefatigably wherever it can force an entrance, but, wherever it is excluded, its work of cleansing cannot be performed. (2.) Decomposition in the open air is comparatively innocuous; but, when the air is excluded, it is poisonous. (3.) A house in this climate is a closed box, from which the cleansing air is apt to be excluded. (4.) Besides its own vitiated air, there ascend into the house foul vapours from the ground beneath. (5.) The house is also in communication with an underground world of sewers, in which the gases of decomposition are constantly being generated while the cleansing atmospheric air is primarily excluded. (6.) All communications from the house to this underground uncleanness are communications to the house therefrom. (7.) The cleansing atmospheric air will find its way into the house if it can; but the sewer air forces an entrance with still greater energy. Now there were three ways in which to meet the difficulties. One plan it was impossible to suggest, viz., the doing away with the appliances altogether. Another plan was to improve the appliances by increasing their complexity, which, he believed, was a mistake; and a third plan was to separate the appliances from the rest of the house, which was the scheme he had now to submit. He would, therefore, make the following proposals:—(1.) To form a separate vertical compartment or *annexe* at the rear of the house, extending from bottom to top, and thoroughly open to ventilation, to contain all water-closets, all sinks, all cisterns, the bath-room, the lavatory, the housemaid's closet, the scullery, and the butler's pantry in connexion. This *annexe* not to communicate with any of the living-rooms, but only with the staircase. All water-closets to have an intervening lobby well ventilated. (2.) To form in connexion with this *annexe* a vertical shaft, extending from bottom to top, and open at the top; to contain the water-supply and service pipes, the gas-supply and service pipes, the flow and return heating pipes, all waste-pipes, all soil-pipes, all ventilation-pipes from the rooms, and the ventilation-pipes from the drains. This shaft to be accessible at several stages, and to be large enough for a workman to ascend and descend by a wall ladder. (3.) To form in continuation of this shaft a subway under the basement floor extending from the front to the back, to contain the house drains, the water main pipe, and the gas main pipe. This subway to have a manhole at each end in the open air. The disconnexion of the house drain from the public sewer, and the provision of all requisite traps, &c., are taken for granted. The efficient ventilation of the public sewer by appliances of its own is taken for granted. (4.) All requisite branch pipes for water, gas, heating, waste, and ventilation to be capable of inspection and control from the shaft, and to extend therefrom to the shortest possible distances. (5.) Every apartment to be separately ventilated by means of tubes in the shaft, and every apartment in the house and in the *annexe* to be directly accessible to the open air by windows. The effectual sealing of the bed of the house against ground air is taken for granted.

Sir Henry Acland, bart., M.D., remarked that a great many of the subjects referred to were better understood 2,000 years ago than at the present time. Some of the works of the Romans in the neighbourhood of Rome and Carthage, and especially as regards their water supplies, were worthy the admiration of the engineers of the present day. Many great cities of antiquity, such as Nineveh and Sardis, he believed, were deserted, not from political causes, but by reason of the ground becoming so saturated with filth as to render them uninhabitable. It would, therefore, take all the care of the scientific men to prevent this in the case of this vast metropolis.

Mr. Lewis Angell, C.E., said that Professor Kerr had suggested a splendid scheme, but it would be a very costly one, and could be only regulated by State control. Almost the only sanitary dwellings fit to reside in at the present time were jails, workhouses, and asylums. He suggested that the Building Act should be applied to the whole country, a fee being paid to the

Local Authority on every new building, so as to provide for an inspecting staff.

Mr. Bourne, the Duke of Bedford's agent, said that a large section of the Bedford estate was built under the conditions referred to by Mr. Hunt. They had their closets outside the house, and cesspools, as there were no other method of getting rid of the drainage, at the time of their construction. Architects could only take things as they found them, and the better part of London consisted of houses built some time ago, which had to be adapted to the present times. More legislation was required with regard to new buildings.

Mr. J. P. Seddon remarked that beauty was an important element in sanitary building. Architects should have more consideration for the work of their neighbours, and then they would not see the horrible messes which were made in London in the matter of façade.

The Chairman agreed with Sir Henry Acland's remarks on the Roman works. In the abbeys of the thirteenth century the sanitary arrangements were as good as they could be, which showed the common-sense of the men of those days.

DRAINAGE UNDER DWELLINGS.

Mr. Charles Barry took the chair at the subsequent sitting, when

Mr. S. Flint Clarkson read a paper on this subject. He observed that however desirable it would be to avoid drains under dwellings altogether, back drainage was impossible very frequently for terrace houses,—those houses put close together which would always line the streets in the central portions of our towns. Anything which was desirable for other drains in less important situations might be considered absolutely necessary for those under dwellings, which should, of course, be as near perfection as possible.

1. *What to Avoid.*—By pointing out briefly the bad qualities of brick drains, such as used to carry away the refuse matter from dwellings, what are good qualities in drains generally may be perceived without an effort. New brick drains are rarely constructed nowadays, but plenty still exist under and round about houses, so that they are not as yet mere matters of antiquarian interest.

In brick drains (and in drains of rubble stone equally) the materials were porous, absorbing liquid foulness, and giving it out in foul air when stirred, half-dry or dry. The bottoms were too frequently of bricks laid flat in mortar; the bricks grew loose, and the bed of the channel became a row of little cesspits. In true barrel drains the round bottom was usually covered with cement, but it was applied with difficulty, and frequently not very smooth. With any slight disturbances the coating cracked, parts peeled off without anybody knowing where. Renewal was out of the question. There were thus always little pools above the porous bricks. Rats worked their way between flat covers and side walls, or enlarged any crack in a barrel. The bad air in the drain found its way into the building, and the rats, too. With bricks, barrels were not made less than 9 in. diameter, which we know is too large for an ordinary house-drain. Little streams of water turned through large flat-bottomed drains were shallow and slow; and in 9-in barrels, with rough insides, there was but little improvement. The solid matter was left behind by the liquids; flushing applied with the most extreme rigour could not cleanse such drains. They were (1) of porous materials; (2) not smooth inside; (3) with joints too frequent, and soon becoming imperfect; (4) too large; (5) difficult to cleanse.

2. *Stoneware Drains.*—All the defects noted above may be avoided if good stoneware pipes are used as they should be. They are manufactured in many places in the United Kingdom, and are not expensive, not nearly so costly as brick drains cemented inside would be. Well-burnt, hard, glazed stoneware pipes absorb no moisture; the vitrified glaze renders them as non-porous (1) as an old-fashioned brown drinking-mug; they do not corrode; they are quite smooth inside (2); once well cleansed the surface is what it was at first.

The fewer the joints the more perfect the drain. If one could be put down all in one piece we should do well, but Nature has apparently not arranged for this. In the stoneware drains joints occur at every two feet, and if properly made they are very lasting (3). [These numbers are those of the defects in the brick drains noted above; the contrast is thus pointed out, and the way in which a defect is overcome.] The length of 2 ft. is convenient for making, firing, conveying, and handling; a length of 4-in. pipe weighs about 15 lb., and a length of 6-in. about 26 lb. In each batch of pipes there are failures which must be cast aside; they should never be sent out from the works. They may be of insufficient thickness, rough on their surfaces, too brittle, fired too much or too little, not cylindrical, or otherwise defective in form. The pipes are made thicker as the diameter is increased: a 4-in. pipe is $\frac{3}{8}$ in. or $\frac{1}{2}$ in. thick, a 6-in. $\frac{5}{8}$ in., a 12-in. 1 in. If too thin or brittle, the broken pipes will saturate the soil around them with foul matter; if rough on the surface, obstructions will occur; in either case the drain will be blocked up. If they are not truly cylindrical in form (or not truly oval in the case of oval pipes), one pipe will stand above another at the joint and stop the flow. An ordinary pipe is constructed with a projecting rim or socket at one end,—a faucet into which the plain end of the next pipe fits as a spigot. The inside of the faucet and the outside of the spigot have parallel grooves to give a key to the material introduced to form the joint.

The lowest pipe is laid first, with the socket at the highest end. The plain end of the next pipe is placed in that socket, and the space between it and the socket is filled in with a mixture of cement and sand. Clay should not be used for drains under dwellings; there the joints should be as air and water-tight and as indestructible as possible. Before the cement has had time to harden the interior of the pipe is wiped out very carefully. *If this is not thoroughly done, a ridge or small lumps of cement will stick up at the joint.* Long hairs, threads, pieces of cloth, or cotton stuff will attach themselves to such projections, soil will then cling, and a stoppage be managed sooner or later. To guard against such ridges or knots joints have been treated somewhat as in iron water-mains, that is to say, strands of gaskin have been put round the upper pipe, so as to make it fit tightly in the socket, and then cement packing, put to fill up the rest of the socket, cannot reach the interiors of the pipes. Some lodgment results, however, and consequent imperfect cleansing, if the whole space between the two pipes is not solidly filled up with something as hard, or nearly as hard, as the pipes themselves.

3. *Some Defects in Stoneware Drains.*—When pipes are ordered hurriedly and arrive too late,—there is sometimes a wish to use those which have come, and not to wait further for the special pipes which ought to have been ordered before. When the changes cannot be made at the junctions,—pipes of one diameter should always be joined to pipes of another diameter by diminishing pipes, and in no other way. Patched junctions are painful shows of inefficiency; obstruction comes sooner or later when the filling-up breaks down into the pipe. Right-angled junctions cause trouble; a branch should discharge through a junction at an angle approaching the line of flow of the drain which is entered. When bends are required, but have not been supplied, straight pipes will be used with apologies, "so as to get the work done," unless there is interference. If the curve is of short radius the spigot ends will actually leave the sockets on their outer sides. Speaking generally, very bad stoneware drains will be of porous pipes, rough in their insides, broken and pieced with cement; some joints gaping, others leaking; some badly made with bad cement, some with projections of the cement inside; not sealed over; laid to curved and irregular lines, with right-angled junctions; the curves made of straight pipes, without diminishing pieces at change of size, and occasionally with larger pipes inserted in the run of smaller ones; without inspection-chambers; put on new-made or yielding ground; parts running up-hill, and the rest laid to flat and irregular gradients.

4. *Iron Pipes and Subways.*—Some architects, in certain parts of their best work, use iron pipes with yarn and lead joints, similar to those in water-mains, in preference to any stoneware drains. In Paris they are always used,—not buried in the ground, but exposed to view. In America they are common, and compulsory in some places for drains under dwellings. They are enamelled inside, or treated by the Bower-Barff (Rustless Iron) process. Mr. John J. Stevenson, the architect of the new mansions at Kensington-court, has taken great pains there, and used all the most modern sanitary appliances. He has kindly lent me a drawing showing the system pursued. Heavy cast-iron pipes, 5 in. diameter, are laid in perfectly straight lines under the houses. They are lined with Dr. Angus Smith's composition, a preparation of tar, which gives a smooth and apparently indestructible surface. Joints occur at every 6 ft., and are thus one-third of the number in a stoneware drain; there are no difficulties with defective cement or the careless use of it. Being much more costly than stoneware pipes, the iron pipes are only used under the houses.

Similar iron pipes were put by Mr. E. C. Robins on wall brackets in a subway,—a kind of sub-basement,—in the Museum of Building Appliances, in Maddox-street, Regent-street.

5. *Lines and Levels.*—Long straight lines are always preferable. It is more easy to get the levels right, and to see that they are so; there are no checks to the flow, which is a very important point with water-borne solid matter; they can be more readily tested at first, and from time to time, and more readily unstopped. At the junction of the straight lengths of the pipe drains, and at any bends, small inspection chambers are put; at the bottom of these a length of half-pipe forms the channel. When the cover is off the character of the flow of the drain is seen at once.

Having determined the lines which the drains are to follow, it is then necessary to settle the inclinations at which they shall be laid, in order that they may convey all effete matter quickly to the sewers, and be self-cleansing. Of course if there was too much fall, and the slightest check, the solids would remain and the water run away. But too much fall is the rarest thing; not being able to get enough is what we are wont to grumble about. The fall is strictly limited by the depth of the sewer below the lowest floor, and the necessity of keeping the drain well under the floor at the upper end; 2 ft. under the finished floor is considered desirable, though we have sometimes to make ourselves contented with less. The least fall approved for 6 in. drains is one in forty, that is 3 in. fall in each 10 ft. of horizontal distance. More is valued if it can be managed, certainly 4 in. drains should have more. It is desirable to have a flow of at least 150 ft. per minute with a shallow stream of water. When drains are laid to flat gradients some special means of flushing them must be used daily.

If the pipes are laid upon yielding ground they will not keep level; some will tip one way and some another, the joints will snap, and sometimes the pipes also, resulting in hills and dales, leaking joints, and stoppages. A bed of cement concrete, carefully levelled on the top to the proper fall,—a bed of artificial rock in fact,—laid along the whole length, will give the pipes a fair chance. In this concrete grooves will be made to receive the lower parts of the pipe sockets, and the whole of the length of each pipe will then rest on an immovable bed.

Refilling the trench must be managed without disturbing the pipes. The hollows under them being very carefully filled up with concrete, it must also be put at the side of the pipes, with a thickness of 6 in. on each side, and then 6 in. over the top. Such a covering of cement concrete is usually stipulated for in by-laws for drains under dwellings, sealing up the pipes altogether as an additional precaution against evil results from defective jointing. It also serves to protect the pipes from displacement by impact on the surfaces above them.

6. *Disconnexion from sewer; ventilation; connexion with sewer.*—After the house drain has left the house, and before it reaches the sewer, a break is made, and the drain runs past an open space. On the side of this air space next the sewer is a water-trap with a good seal, intended to prevent any bad air in the sewer from reaching the air space. If, however, this trap is neglected, or pressed upon a good deal from the sewer, tainted air will not enter the house, but will find its way out of the air space. From the air space fresh air enters the drains under the house, and a current is kept constantly moving through them by arranging ventilating pipes at the higher ends, which shall run up to the top of the building.

Some disconnecting traps are large shaped pieces of stoneware, which shut off the sewer at one end, and receive the house drains at the other. A pipe carried up at the house end supplies the fresh air above the trap, when a grating at the surface of the pavement is

objected to. With other traps the construction of a manhole is contemplated. This is a little chamber built up under the pavement of an area, through which the drainage is carried in half-pipes of enamelled ware. The trap is a syphon or U trap put on the side of the manhole next the sewer. A grating at the surface is sometimes put when there is plenty of space; more usually a flue is constructed and filled in with a ventilator having small mica valves, which rise to admit air into the flue, but refuse to let the air come out. In time of storm there might be a set in the wrong direction,—the long upright pipe at the back of the building might carry a rush of air downwards, and it would find vent at the induct and cause annoyance. Protected by these mica valves, the flue is unsuspect, and a moment of rest allows the pent-up air to go upwards according to its wont. The manhole makes inspection of the drains easy; an air-tight iron cover is often put over it.

The ventilating pipes, at the upper ends of the house drains, are of lead or of galvanised cast iron, well caulked at the joints, and all 4 in. in diameter, or as large as the branches they start from. The soil-pipe serving the water-closet is usually extended upwards; being joined at its foot to the house drains without any trap, a current of air passes steadily through drains and pipes. Long branches must have special ventilating pipes; short ones will be cleared of air by the discharges, and supplied with freshened air from the main drain. These upcast exhaust-pipes must not finish near windows or cisterns, nor be stopped at the eaves, so that they discharge under the open joints of slating; nor must they stop just above the tops of chimney flues, nor be carried into the flues themselves. If they are, bad air will reach the insides of rooms. Wires, or a perforated finial, must be put to keep out birds, or an approved cowl.

The drain should be connected with the sewer in the upper half, above the line of flow, at the haunch just above the springing. The custom at one time was to put the mouths of the house drains below the water-level in the sewers, but this is given up now; the intention was to prevent sewer air entering the drains. Connexions must join the sewers obliquely in the direction of the line of flow of the sewer. The pipe sewer junction blocks invented by Mr. Cockrill, are a considerable improvement. Oblique junction blocks and bends are used for brick sewers. Flap-traps are railed at and still used. The hinged valve allows a passage out from the house-drain, but not into it; the flap closes by its own weight when the flow has passed through.

7. *Inspection, Flushing, and Cleaning.*—Other connexions with house-drains for sinks, baths, rain-water pipes, &c., the traps to them, and the ventilation of pipes and traps, form a branch of our subject not forgotten, but very extensive. The construction, maintenance, cleansing, and the efficient ventilation of sewers might seem another branch. Everybody is interested in it, architects specially so. It is well, however, for everybody to have his own province, and do the best he can in it; and architects are content with a province which extends, in large towns, as far as the walls of the sewers, but not beyond.

When the drains are completed, disconnected, connected, and ventilated, they must be examined keenly before they are used, so that if by chance there are defects, they may be remedied. If the lower end of the house-drain is plugged, and the pipes are filled with water, and left for a few hours, and the level of the water in the testing-bend has not sunk, it has been proved that pipes and joints are sound, that there are no vents for bad air, or cracks through which moisture will run away. The levels of straight drains can be tested by actual measurement, and the effectiveness of the gradient proved by floating down something in a good flush, and noting the time. At cast-iron terminals, with air-tight brass plugs placed in a back area at the upper end of a drain, various tests for soundness and level can easily be applied. With drains in use, water mixed with lime is poured in at the end. By the amount and character of the discolouration of the effluent water, before and after flushing, the condition of the insides of the pipes will be judged.

The beautiful arrangement shown by Mr. Hawksley (470, Class 22) for testing house drains and soil-pipes with a plumber's force-pump and gas pressure gauges, shows when there is any leakage, and localises the leakage too. The traps act as plugs; the ventilating-pipes, and the end of the house-drain next the disconnecting trap, must be thoroughly plugged up. The smoke test calls attention to important defects; little holes may, it is true, be plugged up by some chance at the moment when the test is applied. Straw burned in the drain may send smoke all along it, or smoke may be generated in a vessel and forced in by a machine. These appeal mainly to the sight. The peppermint test,—a favourite one on account of the ease with which it is applied,—appeals to the sense of smell, as does sulphur burned in a shovel at the mouth of the disconnexion chamber. Ether, oil of mint, and other strong smells have been suggested. The difficulty in actual life is in getting anybody to look for defects periodically.

In the discussion which followed,

Mr. Thomas Worthington referred chiefly to the drainage in country districts. Mr. Hugh Lennard considered it a ticklish thing to lay down stoneware pipes which would remain thoroughly water-tight. If that were the case in new houses, what must it be in old ones? He had been long convinced that for drains under houses iron piping was the best thing to use. There was no difficulty in making an iron pipe water-tight, which would ensure people against the saturation of the under-part of their houses through leakage. Col. Prendergast referred to the confusion of mind which existed in the case of ordinary men as to whether iron or pottery piping should be employed. He had seen what was considered a most perfect iron arrangement put in, which had finally to be taken up and replaced by pottery pipes. In the iron piping they found a hole as large as one's fist, through corrosion. This statement brought Mr. Scott Moncrieff upon his legs, who said that before taking to the use of iron piping on a large scale he had made inquiries as to the experience of others, and at the present time there was a conscensus of professional opinion in favour of iron piping. Sir Robert Rawlinson, he continued, had said that as, in London, it was necessary to drain under the house, iron piping should be employed. Even the best stoneware pipes were liable to leak at the joints. Where any doubt arose as to the possibility of corrosion, a subway would enable the user to detect this. He believed the whole question would eventually turn upon the preservation of the iron.

Mr. E. C. Robins, Mr. Edwin Hall, Mr. Dawson, Mr. Fowler, and Capt. Douglas Galton also spoke, the preponderance of feeling being in favour of iron piping.

The Conference resumed its sitting on Friday, when Mr. George Godwin, F.R.S., occupied the chair, Mr. Alfred Waterhouse, A.R.A., being the vice-chairman of the day.

Mr. Godwin made a few prefatory remarks upon the importance of the subjects under discussion. In the solution of such questions no one had more interest than the architect, and the Council of the Institute had shown their appreciation of this by convening the present conference. The more fully the public were enlightened, the better it would be for architects and for the community at large. It was a difficult matter to turn the attention of the public to the subject of architecture, and they rarely gave it a thought unless they were building a house, or had some members of their family down with typhoid fever. Architects had paid less attention to the subjects under consideration than they might have done, but a great change had set in, and ventilation and other arrangements for the protection of health received the utmost attention at the hands of the profession, as well as that covering of beauty which they had always been expected to supply.

THE IMPERMEABLE CONSTRUCTION OF ROOFS, WALLS, AND BASEMENT FLOORS, WITH A REFERENCE TO VENTILATION AND WARMING INCIDENTAL THERETO.

Mr. Edward Cookworthy Robins, F.S.A., read a paper on this subject. He said that the enclosing walls of every house are an important factor in considering its sanitary condition; so also is the roof covering, which together with the walls, constitute its power of resistance to the winds and weather of our inclement climate. Until late years, however, the site covered by the walls and roof of any building, has been thought to be sufficiently protected by them, and the existence of such a thing as "ground air" has been ignored in constructing the lowest ground or basement floors of buildings.

But what is ground air? It is the superincumbent pressure of the external atmosphere which passes through the earth subjected to its pressure to find its escape in the direction of the least resistance, which direction is commonly that forming the site of a house.

When the earth is clean, and the house is pure, there may be no great harm in allowing this process to go on, but for one consideration, viz., the humidity of the air so passing during wet seasons. But in populous places where the earth is fouled by innumerable accumulations of refuse of all kinds, where defective drainage has rendered pestiferous the very soil upon which the house stands, it becomes a matter of enormous moment that the house itself shall not be made the safety-valve for the reception and accumulation of all these abominable impurities in the form of imperceptible "ground air."

1. *Impermeable Basement Floors.*—There are two ways of overcoming this evil. The one is by forming an impervious flooring as before mentioned, and the other is by constructing channels under the floor leading to the kitchen chimney-flue; these channels should be of porous materials, and should be 6 ft. apart, and by being carried to the kitchen chimney the ground air will be drawn off with the heated air and smoke of the chimney, and tend to increase the draught in the flue at one and the same time.

The ordinary materials for paving basement floors are all of a very porous character, but the experiments made on various materials show that hydraulic cement is almost impermeable, and a layer of cement concrete covered with pure cement, or an asphalte surface, or concrete formed of Portland cement mixed with granite or slag chippings and finished with a smooth surface, will answer the purpose desired. But for the sake of comfort and warmth to the feet, it is often desirable that wood should be the covering. This is equally well secured by the adoption of one or other of the many excellent wood block floorings exhibited in this great International Health Exhibition, to be laid on 6 in. of cement concrete. The blocks need not be more than 2 in. thick, and should not be less than 1½ in. thick and 6 in. long by 3 in. wide. They should be dovetail-grooved at the bottom, burnetised before using, and bedded in cement. Powdered cement should be brushed into the interstices after the laying is complete, and the surface well washed with pure water and left clean.

Deal, pine, pitch-pine, oak, walnut, teak, most kinds of wood, will do, which may be planed or polished, and laid in any variety of pattern, equivalent in beauty to a parquet floor. Where there are no basements it would be better that all the rooms should be thus paved, the difference in the purpose of the rooms being expressed by the character of the design and the quality of the material used. Vitreous porcelain tiles are best for passages, being both impermeable and not slippery on the surface. But excellent tiles of every kind are now available for the purpose; and are most easily kept clean.

2. *Impermeable wall construction.*—In the second place, let us consider briefly the case of the enclosing walls of a building. Nothing but the observation of carefully-conducted experiments will enable you fully to realise the remarkable porousness of the ordinary building materials used for the external walls of dwelling-houses.

The impermeable qualities of terra-cotta give it a foremost place in the decorative construction desirable in all buildings.

In the erection of buildings of the ordinary porous materials, however, precautions may be taken to achieve a similar result.

There are a variety of systems for forming hollow walls, the inner and outer casings being connected with strips of bent iron galvanised.

But hollow walls are not always efficient, and are rarely perfectly well done, and, of course, leave a space in which bad air can accumulate, and into which vermin may some day find their way, and being unable to get out, die, and thus fumigate the building. The system is

costly too, and covers a larger area than solid walls when the walls are less than two bricks thick.

There is another system which makes a wall at once air and water-proof so far as it extends, leaving nothing but the crevices in the ill-fitting of the joiners' work of doors and windows, which only good workmanship can eliminate.

It consists of an asphalte bond between the inner and outer casing, applied in the following manner. Let us suppose a 14-in. wall, on one side 9 in. of brickwork, on the other 4½ in., with 1-in. division between, the opposite joints being left free of mortar for about three-quarters of an inch each. At every two or three courses the heated asphalte is poured in, and the crevices all filled up with this impervious material, and the result is a wall much stronger than the ordinary wall, occupying no more space, and perfectly wind and weather-proof. Impermeable water-tanks may thus be constructed, an example of which may be seen in the Parkes Museum.

3. *Preserving Solutions.*—This was the subject of an interesting discussion at the Institute many years ago, under the presidency of the late Sir Wm. Tite, and in the Transactions of the Institute the whole matter was very carefully reported.

I invariably specify that the stone-work shall receive, when in a dry state, two coats of a solution, the effect of which is to render the surface of the stone comparatively impermeable, at all events, till such a time as the stone has had time to weather and form its own skin and natural protector from the weather. Wax and gum are dissolved in a spirit, and the solution is applied with a brush on dry stonework,—the spirit volatilises, and the congealing of the rest forms a skin as thick as the stone is impregnated; two coats are usually sufficient.

At Hanover Church, Regent-street, may be seen three different processes, none of which have, as yet, shown signs of failure.

The building had become perfectly black, but very few signs of decay had taken place, except in the towers, and I was desirous of removing the soot without taking away the weathered surface of the stone, and this I achieved by the use of the wet steam jet.

I also discovered that the portions which had been treated with linseed-oil had not decayed to any extent, while the rest was so far gone that the greater part of the stones had to be replaced.

Of course a great deal of the defective stone we see arises from injudicious selection; there is good and bad stone of every kind, and unless pains are taken not only to select the quarry itself, but to mark the approved stones at the quarry, and then to see that they lie in the building on the same bed that they lay in the quarry, disappointment must ensue whatever the solution you employ; solutions should only be used to preserve good stone, not to make bad stones pass muster.

4. *The Roof.*—The ordinary house-roof is a thing that forms a hat to a building; it may or may not have projecting eaves, or a brim to the hat, but is always presumed to rise above the greater part of the topmost rooms, and to form an air space protective of the inmates from the extremes of heat and cold. That this is but a presumption is, in many cases, only too true, and the cruelty of putting servants in slate, or even metal-covered attics, within a few inches of the outer air, is often forgotten, alike by the builder who sells, and the master who buys his family residence. A sufficient air space between the ceiling and the roof is indispensable for dryness and for the preservation of the timbers of the roof.

The ordinary speculative house-builder gets the thinnest slates, often absorbent of moisture and permeable by the sun and wind, and he fixes these with common nails to sappy battens, secured to light rafters at the least available gauge.

Zinc does not last above a dozen years in the English climate, as a rule; but, if used, it should be put on with laps, and without soldered seams or anything to hinder its free expansion or contraction, and should be put in much thicker than is customary—say No. 15 gauge.

Lead forms the best and most durable roof covering, properly laid, of sufficient thickness,—say 5 lb. weight for the square foot for ridges and flashings, 7 lb. for gutters and flats. But nothing is more effective than tiles, and nothing, when well done, warmer in winter or cooler in summer. The Broseley tiles are admirable in colour and hardness.

5. *Ventilation.*—It is not my purpose to enter very deeply into the question of ventilating and warming, but it is obviously necessary to make suitable provision for ventilation, not only for the purposes of human respiration but for the sustenance of the healthful condition of the materials used in the construction of a house. Dry rot and other forms of premature decay being induced by the want of a free circulation of air about the places where it appears, the best proof of which is, that by the introduction of the air, the growth of the fungus is arrested.

As I have already remarked, the exclusion of the external air from the enclosing roofs, walls, and basement floors of dwellings, renders it necessary to provide ventilation of a simple kind.

If we have something to learn from foreigners of the scientific application of the principles of warming and ventilating great public buildings, as I have elsewhere shown, foreigners have much to learn from us of the domestic comfort derivable from the homely fireside of the English people. That it is wasteful of fuel is true; polluting to the outer atmosphere cannot be denied; nevertheless it is the best system of warming and ventilating ordinary living rooms. Every room in every home in England may be said to be provided with an extract shaft in its chimney-flue from the ever open fire-grate, carrying away in winter 200 ft. of air per minute. But few rooms have any corresponding inlets, and so to supply the omission, whizzing draughts come in through the key-hole and crevices of the doors and windows and floors, and even through the walls themselves.

A hundred years ago John Whitehurst, F.R.S., wrote a pamphlet on the ventilation of rooms by introducing fresh air from without to supply the want of it within, the full particulars of which were given by me to the Institute a few years ago in a paper "On the Relation of Sanitary Science to Civil Architecture." It consisted of tubes placed in the corners of the room, something less than half the height of the same, whose collected area was equal to or greater than the area of the chimney-flue; the air, entering these tubes through the walls below the floors, passed out at the open top with a current sufficient to carry the air to the upper part of the room, from whence it distributed itself without draught like the spray of a fountain, and fed the flue so that no pull was exerted upon the cracks and key-holes afore-mentioned, and the air was changed as many times in the hour as the size of it permitted its exhaustion by the chimney-flue.

When there is no fire the aspiration by the chimney-flue is much diminished, but might be maintained throughout the summer by the use of a ring of gas-jets just over the mouth of the register.

The Hygiastic School Board grates have recently been improved, and the fresh air (warmed in its entrance by passing under the iron hearth and fire-clay back) is brought in with a vertical current through the mantel-shelf instead of horizontally by the stove front, and rises to the ceiling and returns to feed the fire; by this means the cold air is warmed on its entrance, which is not the case in Dr. Whitehurst's plan.

Cowls may be useful to prevent down draught, but must not be relied on for creating upward currents. The best cure for smoky chimneys is Billing's throttle valve and terminal, designed by an architect, which is to be seen on one-half of Somerset House. Why the other half is not done to match it I can't tell you.

CHIMNEYS AND THEIR CONSTRUCTION.

THIS was the subject of the next paper, which was read by Mr. J. P. Seddon, who observed that chimneys, at present at any rate, are integral and important features of most buildings in England.

It may be that they can, and will be, ultimately dispensed with, and our towns made, by the progress of science and economy, to resemble those of the East, and they may become a mere collection of flat-roofed boxes, fed with tempered fresh air and drained of foul air, by some parish pump and heating apparatus. If so they may be left to purely scientific men, to whom æsthetic considerations are questions of superfluity.

I have, however, now to speak as an architect addressing a sanitary conference upon chimneys as they exist, and I wish to show how they can, and should be, treated, so that they may be practically useful and ornamental as well.

They have been both, as witness the graceful chimney-shafts of Grosmont Castle, Southwell Priory, and those of Hampton Court, and a host of Elizabethan mansions, which are picturesque mainly by reason of these features. Alas! they seldom now are either the one or the other, as a glance at the skylines of our streets will reveal, since they are almost invariably disfigured by ugly cowls and tall-boys, which are but records of domestic misery and discomfort. Makers of such monstrosities eagerly compete for public patronage in this Health Exhibition itself, recommending them as palliatives for a disease which they assume to be universal and inevitable. I maintain that it is not the latter, and need not be the former, and that such costly and ugly excrescences may be altogether dispensed with, if proper attention be given to the constructing properly those very necessary portions of our dwellings called chimneys.

Now, why do chimneys smoke? First, because air is not laid on to houses, as water is, but rather sedulously kept out. The more sanitarily impervious (that is to say air-tight) we make our houses the more necessary it is to provide for the admission of air to them, and, unless this be done, smoke cannot ascend the chimneys. Secondly, because fireplaces are ill-constructed and gathered over in such a manner as to leave a large vacant space immediately over them, which acts as a reservoir of stagnant cold air that chills the smoke and prevents its rising to the flue. Thirdly, because flues are made too large (the ordinary size being 1 ft. 2 in. by 9 in.), and because they have no specially expanded places in which down-draughts may expend themselves; and fourthly, because the tops of the chimney shafts are not provided with any guard against the wind, which might be done in a proper architectural manner, instead of it being left to chimney quacks to supplement afterwards with their miserable metal makeshifts,—fantastic excrescences which Dickens has, however, so immortalised that I need not attempt to describe them further. I will proceed at once to consider what the proper construction of chimneys and their appurtenances should be to enable such subsequent appliances to be dispensed with. Beginning at the bottom with the fireplace itself, leaving the grate for later consideration, the first thing to be done is to provide a good and sufficient supply of fresh air from outside the building to the fireplace. This may be drawn from above the roof by special air flues in the chimney jambs.

Fresh air being brought to this point may be tempered or warmed by contact with the grate before its admission to the apartment, and it can be admitted thence without causing a draught, which is sure to occur if cold air be brought to any other part of the room, as its course thence is direct to the fire, to the annoyance of those who may be in its way. How it may be warmed will be seen when we come to the grate.

The next thing to consider is the outlet of the smoke from the fireplace. This should be contracted to the normal size of the flue, at least, or perhaps made slightly smaller, immediately over the fireplace, in order to insure a quick draught. This object is not effected at all by the usual construction of this part of the chimney, which is to put an arch in front, over the opening, and to gather the opening itself to the flue gradually behind. Arch, chimney-bar, and gathering can be dispensed with, and may be so economically, by forming in Portland cement concrete *in situ* a mantel-block extending the full width of the wall, and 9 in. longer than the opening, and 9 in. deep, with three circular holes pierced in it, each 8 in. in diameter. The central one is the outlet for the smoke from the fireplace, and the commencement of the smoke flue; the side ones are for outlets from the spaces to be formed around the grate, for warming the fresh air brought to them, and are the commencement of flues to convey the warm air to gratings for its admission to the apartment which may be arranged in connexion with the chimneypiece, or carried up to just below the ceiling or the cornice.

The construction of the flues from above this mantel-block is the next point to be considered. These are ordinarily made 1 ft. 2 in. by 9 in.,

but this size is too large; they should not be larger than 9 in. square, and are better lined with fireclay pipes, 8 in. in clear diameter; the inside surface of these pipes should not be smooth or glazed, as such are said to be found to retain soot only till rain falls, when it becomes loosened and drops suddenly, causing annoyance, whereas the ordinary terra-cotta surface is rough enough to retain the soot till the chimneys are swept.

Midway between the top of mantel-block and ceiling line of apartment, the flue should be expanded and formed in such a manner as to break the line of ascent of the smoke, and to provide a flat space immediately under the upper part of the smoke flue, in order to divert down-draughts of air impinging on it, and give them a rotary direction, first sideways and then upwards, within the expanded place provided for the purpose, without stopping the upward current of the smoke from below. When the flues are lined with fireclay pipes, special expanded pipes, which are made for the purpose, can be introduced, and more than one in the height of the flues may advantageously be used.

The construction of the chimney-stacks containing the flues above the roofs should be such as to protect them from cold and damp to which they are exposed. It is well to build them in cement and to line them with pipes; but the tops need careful arrangement, because the exit of the smoke from them is liable to be disturbed and hindered by winds. There should be at the top of each flue an expanded vacuum space, within which down-draughts may rotate and expend their force, and there should be louvred openings directing gusts of wind upward so as to assist, instead of retarding, the exit of smoke. All this may and should be executed in proper architectural materials and form, as stone, brick, or terra-cotta (the last-named material is specially suitable and easily manipulated for the purpose).

So much for the construction of the several parts of a chimney, namely, the fireplace, flues, and terminals, which need consideration as a whole, without which it is hopeless to expect success by the use of any of the numerous special appliances for the separate parts alone. I plead earnestly for these principles, as a matter closely connected with the health and comfort of the community, and specially invite discussion as to them..

There is, however, another point, which is, perhaps, not less important, but as to which what I have to say is more tentative and experimental. It relates to the grate within the fireplace.

Burning coal as we do, the main point, I think, we have to seek is the consumption of its smoke, or as much of it as is possible within the grate itself, so that the office of the flue should be to convey away the gaseous products only, and not soot. It appears to me that this is attainable by diverting the smoke after it has issued from the top of the fire, so that it should be passed again through the body or flame of the fire before it ultimately reaches the flue.

Perfect combustion is, I think, of more importance than what is called "slow combustion," and a fire should not be smothered in its own ashes.

The cheerful English open fire is not likely to be driven out of fashion by even Health Exhibitions, and I do not think that the health of the public would be improved by the substitution of the close stoves in apartments which obtain more generally on the Continent and in America. Nor do I think that any of the systems proposed for keeping up throughout a dwelling-house the same temperature, are likely long to curtail the liberty of the English subject to make the room he occupies of the temperature he pleases. I certainly should not advise the most ardent believer in such a system to expend capital in building houses at present without fireplaces, with their separate flues, or to dispense with chimneys and their construction.

The warming of the fresh air brought to the fireplace is to be effected sufficiently by its passage down the flue and round the fireplace, care being taken that no smoke can penetrate to these spaces. The object is rather to temper than to heat the air, and to direct its point of admission to the apartment, so as to obviate unpleasant draughts. The air so tempered around the kitchen fireplace would be most usefully employed by being brought to the hall of the house which supplies air to all the rooms, with means of shutting it off when not wanted in summer.

The ventilating grate or stove is, then, an essential part of the combination of appliances I would suggest for chimneys and their construction. And there are many excellent contrivances of this class in the Health Exhibition which can be highly recommended.

The best method of curing chimneys of smoking would, however, obviously be by consuming the smoke in the grate itself, and allowing nothing to pass up the flues but the heated gaseous products that necessarily remain even when the soot has been consumed.

I cannot see that this has as yet been altogether effected by any of the appliances for the purpose exhibited, although many praiseworthy efforts to do so have been made. But this is, in my opinion, the direction in which we are to look for further improvement, and to perfect chimneys and their construction.

In the discussion which followed the reading of these papers,

Mr. Charles Forster Hayward, F.S.A. said the advantage,—not to say the importance,—of having such parts of dwelling-houses as floors, roofs, and walls constructed in a manner so that they may not be too open to the influences of atmospheric changes, might at first sight seem self-evident to every one; but this point was enforced in the first paper just read, connected, as it necessarily was, with the second paper, which referred more particularly to another detail of construction, so essential in this country and climate not only to comfort, but to the possibilities of ventilation, viz., chimneys. Their point, therefore, was to discuss the effect of permeable or impermeable, porous, impervious walls, floors, and roofs,—impermeable to (1) air, bad and good, including heat and cold; (2) water, *i.e.*, damp and rain. If time permitted, these two aspects of the question might well be separately considered, but merely hinting at the ideas expressed by Pettenkofer and others as to the extent to which walls were permeable to air, he might at once say that if we would ventilate at all scientifically, and in any but the most simple and elementary manner, we must have walls and floors impermeable to atmospheric effects. Thus, if any sudden changes of heat and cold could to any great extent affect the interior of a building to be ventilated, all special arrangements would be upset, and obviously the introduction of wet and damp through the walls would greatly militate against any artificial means employed to ventilate. Impermeable floors in the basement were best secured by asphalte in some form, either as a layer on concrete with a smooth surface, or as a bed for wood-block or other such flooring, such as small joists bedded in or on the asphalte, to which joists the flooring may be nailed. Other floors of a similar or inferior nature might be used, such as cement, &c. Impermeable floors above the basement were obtained by the use of rolled iron joists and concrete, with asphalte or cement covering, or perhaps with a wood-surface as before. But this touched on the question of fire-proof construction. So he would only refer to a modification of those impervious floors, such as wood joists filled in with concrete or pugging, and then a surface of cement or tiles, and this he had often used for school passages, where fire-resisting material was sufficient, in opposition to fire-proof construction. They might remind themselves here of the old plaster floors of Nottinghamshire and elsewhere. As regarded wood-block flooring, he would remark that in one case he used some wood blocks bedded in a substance like asphalte, in a very damp basement, which had stood perfectly twenty years, and a similar one,—a French patent,—had best borne the wear and tear of an outer entrance-door for as many as ten years already. Now it was obvious that in these floors one must give up all the contrivances for ventilation through the floor, and omit all calculation as to air finding its way into the room through the floor (charged sometimes with the dust of the carpets and other objectionable matter). Also all the need of air-brick ventilation for the floor itself to keep away dry-rot, &c. Yet these floors would be all the more suitable for laying on air in pipes bedded in the substance of the floor, this being more rigid than the ordinary wood-joist floor construction. Passing this, he came to the walls, which were obviously imperfect if built of porous material, whether of brick or stone, or with imperfect joints, or without damp-courses, either vertically or horizontally, either in basement or chimneys, where necessary. Hollow walls were well known as expedients which required careful work and some experience to make effective. Even all the galvanised iron ties, twisted and bent upwards, and the patent brick bond, were not enough unless care be taken to prevent lodgment of lumps of mortar, &c., during construction, so that in building hollow walls a space for taking out these below is best left to the last. Then the jambs of windows were difficult to manage, and other points required attention; but it was certain that two walls half a brick thick are better than a 9-in. solid wall to resist the wet; and that an outer stone construction should generally have a lining of brick a slight distance from the inner stone face to secure a wall impermeable to wet. But the best of all as against wet, though not always as against wind and draught, was vertical external covering of tiles or slate. The former obtained in such districts as Surrey and the latter in Cornwall and elsewhere. The use of substances such as Hygienic Rock cement in place of mortar for joints or as a coating internally of hollow walls, to prevent access of damp and weather was to be commended, but of the substances advertised for coating walls externally, little advantage might be expected, and less for those often mentioned as being certain specifics against damp, &c., internally. Certainly he should not think of such as affording means for what we call "impermeable" walls. Roofs might be made impervious as floors, and when so made would obviously be flat or horizontal, not sloping. For ventilation purposes this was not an unmixed advantage, for we had to give up the space between ceiling and roof so often; but for access to chimneys and for many town purposes a flat roof was in various ways desirable. Now, to ventilate and warm,—we must in thinking how best to utilise our impermeable constructions, remember that we have to feed the human lungs first, and, secondly, the fire. When warming was not required, only human beings had to be thought of; but the chimney might be of great use, or, at any rate, if it existed, could not be ignored in any system of ventilation. Ingress of air was best secured by such tubes as were well understood as Tobin's (a convenient though inaccurate name for them), because they could be regulated in height and size, and by small valves and doors; they also could be placed regularly around a room away from an outer hall, being supplied from the other side by tubes laid in the floor. The hollow channels formed in the walls, with ingress into the apartment at the cills where they were unusually high above the floor, had been found best in some cases where he had had to solve the problem practically. The same arrangement of tubes laid in the floor could be adopted to feed the fire, either in the hearth or at the cheeks at the side jambs; and, of course, the air could be brought in the same way to the back of the grate or stove, if so prepared to receive it, and there be warmed and distributed. Additional access of air could often be obtained,—indeed, sometimes only so, by spaces over the door-head, filled in with louvres, or by special ventilators made for doors, cutting into the mid rail, and avoiding, at least, the necessity for opening the doors and preventing cold draughts to the feet. One of these systems he had applied to school-rooms, and opening on to a corridor; the other to work-rooms of milliners and others. For egress of vitiated air, the chimneys come into use, with talc-valve and other ventilators, but specially-built flues were best, lined with circular or square fine piping, but with regulating valves, which were so seldom used. Either accidental or artificial heat, such as gas burning in the tubes, should be used to keep up the essential draught. If it were congenial to our notions of comfort, those Continental tile stoves with tall flues going right through the rooms to the roof might be made to afford, effective egress of vitiated air, being conducted by the heat either into some adjoining flue or other ejector. The sum and substance of all this was a strong recommendation to the householder to procure, and so, of course, be willing to pay for, what was necessary to provide good impermeable walls, floors, and roofs, if he would have a preliminary to good ventilation, or even warmth and comfort, without draught.

Mr. Ralph Nevill differed with Mr. Seddon

as to the size of the chimney-flues, his experience being in quite an opposite direction.

Mr. Wm. White considered that the size of the flue was not of so much importance as its proper construction. With regard to walls, he had seen, in the case of a storm, on the inside of 9-in. brick, the water bubbling through with the air. Felt had frequently to be removed on account of the mildew and dry-rot it created, and he was endeavouring to substitute the Willesden paper for it. At the same time, felt was one of the best non-conductors of heat and cold. To render a floor impermeable, Dr. Richardson had recommended the turning of arches over the whole of the space under the floor. He considered the wood-block flooring more durable than the Staffordshire common paving tiles.

Mr. Schmidt remarked that he had found that Tobin's system would keep rooms well ventilated.

Major Rowe, President of the Sydney Institute of Architects, said that in Australia they had greater difficulty than in this country in finding good materials. It was generally necessary there to coat the walls with cement externally to keep out the damp. The common clay brick was useless for keeping out the rainy weather, and cement was largely used for ordinary houses in Sydney, but even that was not always successful, on account of the inferior work. When not under the control of an architect the cement was only put on about three-eighths of an inch thick; but whenever it was faithfully mixed and fairly put on it resisted the weather. They could get glazed bricks, but then the cost was considerable. From experiments made by himself, he had found that the sandstone which was largely used for building in Sydney, after it had been some time exposed to the air, was more damp-resisting than any quality of bricks they produced. He had seen in the *Builder* diagrams of an impermeable mode of building, which he was strongly in favour of. He considered 9 in. by 14 in. the best size for flues.

Colonel Prendergast thought that each separate apartment in a house should be ventilated by itself. He doubted the advisability of excluding all ingress of air through the walls. The removal of the vitiated air from the top of the rooms, although it had not been touched upon, was a matter of the most vital importance. He thought architects ought, when designing new houses, to make provision by which, at some future time, the vitiated air would be drawn off by channels from the tops of the rooms.

Mr. Waterhouse, A.R.A., drew a sketch on the black-board of an idea for getting rid of the vitiated air from the upper part of a room by making use of the ordinary flue. This was simply by having an opening at the top of the room connected with the smoke-flue over the mantel-bar. The draught of the chimney drew the foul air from the top of the room, while he had never found the smoke enter the room through the opening. He was making a plan at the present time for a physician who insisted that there should be nothing but solidity between the ceiling and the floor above.

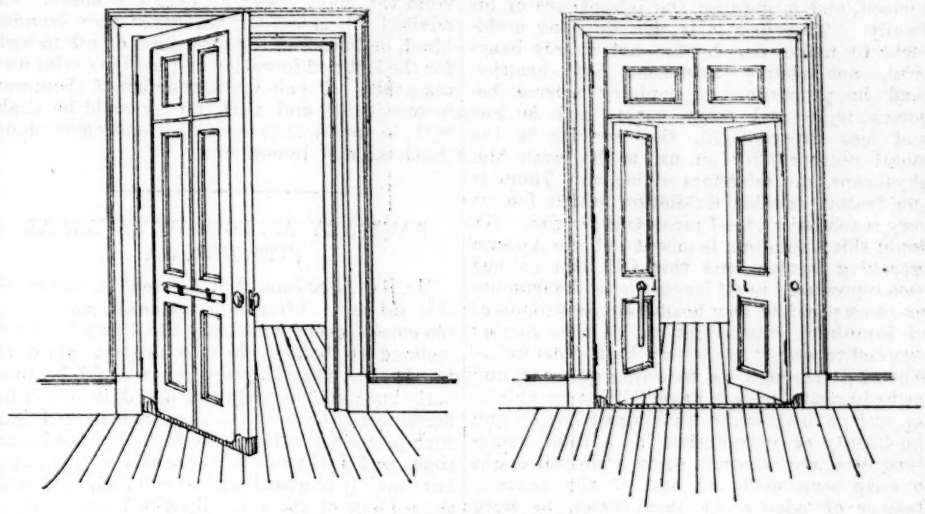
Mr. Ewan Christian having taken the chair, Mr. Horace Jones read a paper entitled

SUGGESTIONS RESPECTING DOORS AND FIRE-RESISTING CONSTRUCTION.

He said,—A consideration of many of the unhappy occurrences during the terrible catastrophe of fire within my own memory has induced me to formulate "A Suggestion with regard to the Construction of Doors, so as to afford opportunity of Escape from Fire." I append a list of the more prominent cases in which, by the newspaper accounts, some 5,000 lives are alleged to have been lost. Supposing this is somewhat exaggerated, and there is only one-half or even a fifth of that amount, it will still be a horrible and terrible tale to record against the builders and designers of public buildings.*

Such, then, are the reasons which prompted my "suggestion,"—a suggestion applicable to the large doors of churches, theatres, concert-rooms, or other public buildings, also the street or entrance doors of mansions, hotels, boarding-houses, or any other place where numerous inhabitants are likely to be in occupation; also to the subsidiary doorways of public buildings, which are only to be in use either for egress under special circumstances, such as panic or accident, or for ordinary egress.

The diagram will almost explain itself. If the unfortunate victims crowding and blocking



the door with frenzied fear but not unnatural panic, found suddenly that this blocked door, opening inwards upon them, had a means of safety in itself, by simply opening outwards the folding wicket framed within the door, their chances of escape from almost certain destruction would be very much enhanced, and their thankfulness can be better imagined than described.

Of course if the height of the door admitted it, the upper panels would be framed solid, the wicket opening and shutting to and from the transom only.

I would here observe that the cost of the extra labour in forming doors with these wickets, as shown by the model, would not be very large, a very small percentage upon the cost of an ordinary door being sufficient; the principal expenditure, of course, would be in the additional hinges and fastening, although the latter could be of any kind, from an "espagnolette" bolt down to barrel bolts or bars. They would, of course, open only from the inside, and either by sealing or other methods ensure detection where they had been unnecessarily tampered with.

I admit that wickets are often applied to large doors or gates; these wickets are, however, very small, very inconvenient, and generally open the same way as the gates.

I will now proceed to call your attention to a form of construction, or rather an application of the different qualities of two of the best-known and most universally-used materials.

Some years ago I had occasion to visit an engineer's workshop or factory that had been then quite recently destroyed by fire,—indeed, the ruins were still smoking,—and these shops consisted principally of two or three rather lofty storeys. A curious circumstance immediately presented itself: the beams or girders were composed generally of three distinct kinds, viz., cast-iron, wrought-iron, and timber.

I found that all the cast-iron girders, of which there were several, on the ground, broken in pieces; the wrought-iron laying, or rather hanging, from the upper floors, twisted into various shapes; the wooden joists generally entirely consumed, nothing but some small remnants of charcoal indicated where they had been; but there were two wooden beams, which, for some special reason, had been cased on two, and perhaps in some parts on three sides with thin iron plates. These beams alone remained *in situ*; both were well laden, and supported heavy and massive articles.

I inferred from this that the application of the thin plates to the sides of the timber prevented the combustion of the timber, whether by preventing the atmosphere getting at the fibre of the wood, or from any other cause, is immaterial as long as the result is the same.

As a proof to myself and the engineer whose premises were burnt, he tried the following experiment, viz.:—Selecting two or three pieces of ordinary timber, about 6 ft. or 8 ft. long, and say 6 in. by 4 in. scantling, and covering half their length with thin iron, bolted through on two sides. He had them placed in the furnace of a steam engine; in a short time the uncovered or unprotected wood was entirely consumed, the parts protected had the sides charred, of course, but the middle of the scantling, desiccated thoroughly, yet quite sufficiently firm and solid to carry nearly, if not quite, its original load. Acting on this information, several floors were executed, for instance, in the Sovereign Life Office, corner of St. James-street and Piccadilly; the British and Magnetic Telegraph and Submarine Station, at the rear of the Exchange, Threadneedle-street,—one floor in each, dividing portions of the building separately occupied; in some warehouses also for the storage of valuable goods, &c.

Of course the progress of improvement would naturally adopt some of the many useful and ingenious modes of constructing fire-proof floors, such as using rolled iron joists quite covered or embedded in concrete; but there are times when a different mode of construction may be advisable and the application of a useful beam of wood rendered fire-proof by the thin covering of iron not be neglected. Of course the embedding in concrete of iron will also apply to wooden joists without the protecting iron case, and, if so, an economy will be the result. Few fireproof floors can be constructed under 6*l.* or 7*l.* per square. I am, however, informed of one in which the constructors claim they can construct it at 5*l.* 16s. 9d. per square.

I have inquired of a respectable and well-known firm of surveyors their estimate of the cost of fireproof construction according to the section given them, and also the cost of ordinary flooring; and they find that the cost of this floor would be 4*l.* 10s. 6d. per square, or about seven shillings per square less than the cost of ordinary flooring.

In the discussion which followed,

Mr. Henry Dawson considered that no absolutely fireproof method of construction had yet been devised. The better term to use was "fire-resisting," and such substances as bricks and terra-cotta, which had been subjected to intense heat, were the best suited for this purpose. Unless protected externally with Portland cement, manufactured iron, although it had been subjected to intense heat, was unreliable. With regard to Mr. Jones's door, it should have an inscription on it stating that the bolt was to be drawn in case of panic. The want of the bottom rail, he considered, must interfere with its construction.

Mr. Jones replied that his first model had the bottom rail, but he was afraid it might prove a trap for people falling over. These doors cost 10 per cent. more than ordinary doors.

Mr. William White remarked that it was not generally known that an Act of Parliament ordered that the doors in public buildings should open outwards. In the case of a concert-room, he had designed a door, divided into two parts, one opening inwards and the other outwards.

The last Conference of the series was held on Saturday, the 12th inst., when the Right Hon. A. J. B. Beresford-Hope, M.P., was chairman for the day, with Professor T. Hayter Lewis as vice-chairman.

The Chairman said.—It was a right and happy idea of the Institute to come forward and claim its own share in the Health Exhibition. What can be the good and the meaning of architecture

* We omit the list, most of the particulars of which have been reported in our columns.

if it is not the science of contributing to health, happiness, and longevity in the most permanent of all circumstances of a man's life, viz., his house? His boots and hats wear out, his clothes get shabby, his food perishes in consuming, but his house ought to be a part of himself, and it may be the inheritance of his family. Therefore it is our duty as architects to make our houses not merely beautiful, not simply luxurious, but healthy. And in proportion as sanitary science becomes more and more exact, and is less and less experimental, the heavier is the moral responsibility on us, to be with the physicians, the ministers of health. There is one feature in this Exhibition which I have very much enjoyed,—I mean Old London. No doubt this Exhibition is meant to be an Apostle preaching health, and this Old London has been reproduced in all its exquisite picturesqueness as a proof of how beautiful and delightful an insanitary city might be. I was almost tempted to say, "An enemy hath done this." When I go through its frowning gateway, and see its beautiful houses, I say, "What can this be for, except to show the humbug of health and the beauty of insanitation"? I think something else was wanted; some approach ought to have been made to one of the cunning framers of odours, in Bond-street, to have supplied the standard odour which the Mediæval town would probably have yielded to the passer-by. Instead of that broad footway, should there not be gurgling down the street,—not a trout stream, but one of a good deep chocolate colour, such as filled the central roadway of our Mediæval cities? And, instead of the hard path, should there not be that delicious yielding substance, composed of many materials, which was what the Mediæval ladies and gentlemen had to pick their way through? If all these things had been provided our street of ancient London would have been far more correct in its appointments. As it is, the beauty is apparent, the insanitation remains to be guessed. A short time ago,—and I am glad to have this opportunity of pointing it out to you,—I was very much struck by a print which appeared in the *Builder*, from the pencil of one who is well known as an artist and an archæologist,—I mean Mr. Brewer. It was exceedingly picturesque and exceedingly sad. It represented a Mediæval town, all capitals and carvings, clustered round a minster of exquisite Gothic proportions; but not a human being was to be seen in the engraving. In the accompanying letter-press, Mr. Brewer explained that the idea was that of a city that had been desolated by plague, and which was then uninhabited. The buildings were mainly Gothic, with some Renaissance among them, and it seemed to be a deserted city of, say 1508. And in the middle of it all there was a sluggish stream running, with some broken steps, down which the maidens had gone to get their drinking water. A little further on this stream lost itself by a low-browed archway under a house, and was, in fact, the common sewer and common conduit. I was very much struck by it; there was something so extremely pathetic about it; the great beauty of the whole, and yet the history it revealed of the sufferings and the agonies that had attended the long plague by which the city was ultimately desolated. I would say that that engraving, alike in its teaching and for its great artistic power, deserves to be perpetuated in a more permanent form than even in the current weekly numbers of the excellent journal in which it appeared. Mr. Beresford-Hope went on to say that it was important in sanitary matters to carry health into existing buildings. It was not merely the work of the "jerry"-builder they had to deal with and put right, but many of the most stately and luxurious buildings. There were no more treacherous buildings than those of the last generation, when mechanical science had attained a high perfection, but when chemical investigation had not equally advanced. He then spoke of a certain house at the West End of London, which nearly fifty years ago was overhauled regardless of expense by a man enlightened according to the views of those days, and fitted with all the most charming appointments of high London life. Among other things with which it was provided was a service of hot-water to most of the bed-rooms. In a few years this house changed hands, and the hot-water apparatus was cut off. Years rolled on, but now and then strange smells were smelt, and people felt strangely heavy and depressed in certain rooms. At length, not many years since, an investigation was made, and this disused hot-water service was found to be in reality a machine for diffusing, without trap or hindrance, sewer gas fresh and rich from the main sewer, all over the house. He advised all, therefore, whenever they bought, hired, or inherited a house, first of all to look for the lost and forgotten and hidden drains and cesspools. He believed the number of these was inconceivable, and that if they could be dealt with, it would have an important effect upon the death and disease-rate.

SANITARY ASPECTS OF INTERNAL FITTINGS, &c.

Mr. G. Aitchison, A.R.A., read a paper on this subject. After some general remarks on the conditions of a sanitary life, he said,—I am inclined to believe, in the present state of London air, that if every house could be properly built and properly ventilated, it should be hermetically sealed to the outer air; but I fear such perfection is hardly to be looked for in our time, and I therefore say that the things we have mainly to guard against are dirt, dust, and the fouling of the air. By dirt I mean, when speaking to an audience like the present, the street mud we bring in with us, consolidated external and internal soot and dust, and such soft matters that are occasionally dropped about, such as particles of food, and the like. Every crack in a floor gets filled with this, so it is of the utmost importance that this dirt, if not to be excluded, should at least not rest for ever with us, and be liable to putrefy when exposed to damp and warmth. Every open joint between the floor-boards and beneath the skirting is usually filled up flush with dirt. Besides the dust from the streets, we make our own dust inside our houses,—particles from shoes, from wood and stone, from our clothes, oil-cloth, mats and carpets, are constantly being worn off and carried for a time in the air, together with the scales of our constantly-renewing skin; and as soon as the moving air is overladen or becomes comparatively still, everything is covered with light dust, and a great deal of this dust is what the doctors call septic, or putrefying dust. Mr. Brudenell Carter, the eminent oculist, in his letter to the *Times*, described how he had reduced this to a small amount, and that, in consequence, the health of his family had improved. As regards floors, constant wetting is not wholesome, and even scrubbing will not remove dirt far down in the crevices of boards. Nothing is better for preventing the permanent location of dirt than really good hard wood polished parquet, but if that be found too expensive, then let the joints of the boards be well scraped out, filleted with wood when wide, and let all the joints be puttied. And let the whole floor be painted or varnished; dust is then more easily and completely swept up, and a wet flannel cleans the floor; but with parquet perhaps a washing once a year is enough with clean sweeping, and the wholesome application of turpentine and bees-wax.

These remarks apply also to all open joints in woodwork, furniture, and plastering; they all get filled with dust, and should be puttied up, and the dust kept out. Smoothness of surface is also a great help to cleanliness, and certainly as few ledges and holes for dust as possible should be left where the parts cannot be daily dusted. This particularly refers to wall surfaces, and to undercut ornaments in cornices and the like; tall bookcases and cabinets always have their tops covered with thick dust.

As to woven things, whether of cotton, wool, or silk, the less there are of these about a room the better; and wholly carpeted bed-rooms are simply an abomination.

What is still worse than a carpet, which is usually beaten yearly, is tapestry or other woven hangings, which often remain in position until they are worn out. Blinds we must have, but they can be glazed, and they generally get a yearly washing; but we might altogether abolish door and window curtains, and woven mantel-shelf coverings, and such like follies. It would also be healthier if we covered our chairs, seats, and sofas with leather, instead of silk, velvet, or cotton. The gilt and enamelled leather we can get, if not quite so beautiful in point of sheen, may be of excellent design and harmonious colour.

Next to polished wood, tiles, marble, glass and marble mosaics, the best wall finish is oil paint; this can be made agreeable to the eye by simple flat tints of harmonious colour, or it can be ornamented with floral or arabesque ornament, or with the highest triumphs of the painter's art, and this last will not only mark the owner's real taste for art, but will prevent the accumulation of dust on the picture frames.

Flock papers should never be used, except when they are painted over, as they form a natural receptacle for dust, and seem to absorb the greatest quantity of foulness from the air, and when the flock is not dyed "in-grain" whenever they are touched some of the colouring matter comes off and is mixed with the air of the room.

I am greatly inclined to recommend the varnishing of all papers, they can then be cleaned with a sponge; but it is absolutely essential to varnish them in nurseries. Children will lick the papers, and neither lead, copper, nor arsenic can be good for them, and neither size nor whitning are substances you would give to children without medical advice.

Let me say here that you cannot have your windows cleaned too often. When they are dirty they not only exclude light and sunshine, but are covered with thickened human exhalations and dust. If you are wealthy enough to have a dressing-room, banish into it every superfluous article from the bedroom; half the bedrooms in London are encumbered with cupboards full of boots, and wardrobes of old clothes, with baskets for dirty linen, books, ornaments, curtains, carpets, and the like, not to speak of mouldy sponges, nail and tooth brushes; these things occupy some of the air space, and pollute the remaining air with their exhalations.

I have no doubt that beauty of form and colour have a very important effect upon our health. All of us can bear witness to the dulness of a room of one colour, in which we have to sit when we are without occupation, and the desire we then have for some beautiful and intricate pattern to relieve its monotony. When a room is adorned with pictures we have not merely occupation, but delight, and those higher emotions that are only excited by the fine arts. When we choose wall-papers, those that are more beautiful in form and colour are to be preferred. We should, however, satisfy ourselves that the patterns on the papers with which our rooms are hung have not a look of motion. Nothing is more distressing than to be in a room where the pattern of the paper seems always crawling like a bag of worms. It would be well if we could have all things about us beautiful in form, elegantly simple, and all the colours harmonious and restrained; these great qualities seem to impart to us the feelings of self-restraint, dignity, and repose.

[For further particulars of Saturday's Conference, see p. 99].

The Sanitary Assurance Association.—At the ordinary monthly meeting of the Council of the Sanitary Assurance Association on Monday last, Professor T. Roger Smith, in the chair, a paper on the sanitary exhibits at the International Health Exhibition was read by Mr. Mark H. Judge, by whom it had been prepared at the request of the Council. On the question of the disconnexion of house-drains Mr. Judge said:—Arrangements for providing a free passage of air into drains on the house side of the outfall traps, to form an air-break or disconnexion between sewers and house drains, are now admitted to be necessary by all sanitary authorities; indeed, the principle involved in their use is the cardinal principle of modern sanitary architecture. By means of the outfall syphon-trap, combined with air-disconnexion and outlet-ventilation above the roof, a dwelling is thoroughly protected from the ingress of sewer-air. That it is important that the admission of sewer-air to our dwellings should be prevented is universally admitted, even when no infectious disease-germs are present in the sewers; but it is often a matter of life and death. Who, indeed, would be bold enough to assert that the miles of London sewers into which every house is supposed to drain in this great metropolis, with its 4,000,000 of inhabitants, are ever free from infectious disease-germs? These sewers drain alike the palace and the worst tenement-dwelling in which poverty and ignorance breed disease and invite death.